



# **MARKSCHEME**

**May 2011**

**BIOLOGY**

**Higher Level**

**Paper 2**

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## General Marking Instructions

### Subject Details: Biology HL Paper 2 Markscheme

#### Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**32 marks**] and **TWO** questions in Section B [**2 × 20 marks**]. Maximum total = [**72 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized.
9. Only consider units at the end of a correct calculation.

## Section B

### Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:  
     expression of relevant ideas with clarity  
     structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

#### Clarity of expression:

*The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.*

#### Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

### SECTION A

1. (a) 90 (minutes) [1]
- (b) as temperature increases activity increases/positive correlation [1]
- (c) avoid predators / less competition for food [1]
- (d) as temperature increases metabolic rate decreases/negative correlation  $\left\{ \begin{array}{l} \text{(accept} \\ \text{converse)} \end{array} \right.$  [1]
- (e) metabolic rate of group mice is always less than single mice;  $\left\{ \begin{array}{l} \text{(accept converse)} \end{array} \right.$   
 both follow similar pattern of increases/decreases/fluctuations at same time of day;  
 fluctuations greater in group mice;  
 both most active/higher metabolic rate during  $\left\{ \begin{array}{l} \text{(accept any reference to times} \\ \text{evening/21:00;} \end{array} \right.$   $\left\{ \begin{array}{l} \text{between 18:00 and 00:00)} \end{array} \right.$  [2 max]
- (f) single mice need to produce more heat/have greater heat loss because of greater surface exposed to air / group mice huddle together to reduce the surface exposed to air [1]  
*Allow any other reasonable answer.*
- (g) oxygen is required for (aerobic) respiration;  
 respiration produces ATP/releases energy/heat in the mice;  
 metabolic rate is a measure of total energy released/consumed in the body /  
 oxygen consumption is proportional to energy released/consumed in body/  
 proportional to metabolic rate; [2 max]
- (h) metabolic activity high when mice more active supports the hypothesis;  
 activity is normally correlated with energy consumption;  
 but another factor may be causing both to increase at the same time / correlation  
 does not always establish cause and effect;  
 grouping/environmental temperature also affect metabolic rate; [2 max]
- (i) I. cristae;  
 II. matrix; [2]
- (j) increase surface area to allow more reactions/cytochromes/proteins/energy release/ATP production/electron transfer/proton transfer [1]
- (k)  $\frac{12}{20000}$ ;  
 $= 6 \times 10^{-4} \text{ cm}$  **or**  $= 6 \times 10^{-6} \text{ m}$  **or**  $= 6 \mu\text{m}$ ; [2]  
*Allow other correct answers with correspondingly correct units.*

2. (a) (i) phosphate [1]  
(ii) covalent / phosphodiester [1]

- (b) only the antisense strand is transcribed / the antisense strand is transcribed to mRNA and the sense strand is not transcribed/has the same base sequence as mRNA (with uracil instead of thymine) [1]  
*To award [1], reference must be made to both strands and transcription.*

(c)

prokaryotic DNA	eukaryotic DNA
circular	linear;
in cytoplasm/nucleoid region	enclosed in nuclear membrane / in nucleus;
naked	associated with proteins/histones;
plasmids	no plasmids;
both prokaryotic and eukaryotic DNA consist of a double helix of (deoxy)nucleotides / phosphate, deoxyribose and base/ATC and G;	

[2 max]

*Award marks for paired statements only. Answers do not need to be shown in a table format.*

3. (a) removal of waste products of cell reactions/metabolic activities/pathways [1]  
(b) blood (in the glomerulus) under high pressure caused by difference in diameter of (afferent and efferent) arterioles;  
fluid plasma and small molecules forced into kidney tubule/Bowman's capsule/  
through fenestrations/basal membrane;  
which prevent larger molecules/blood cells from passing through; [2 max]  
(c) *difference*: fluid at II has less urea/glucose/oxygen/salts/ions/water;  
*similarity*: fluid at II has same (amount of) proteins/blood cells as fluid at I; [2]  
*Accept converse for both marking points.*

4. (a) (i) diatoms / (other) algae [1]  
(ii) trout [1]  
(b) nutrients are recycled in a food web and energy enters and leaves/is not recycled;  
nutrients are recycled by saprotrophs/returned to environment and reused;  
while energy (enters as light and) is dispersed as heat; [2 max]  
(c) (the shape of pyramid) shows energy lost from base to top of pyramid/80 to 90%  
lost at each trophic level;  
(because) energy is used/released through cell respiration/heat/metabolism/  
movement (at each trophic level);  
not all tissues are eaten *i.e.* bone/hair/cellulose/excretion/undigested/die (so energy  
is not available for next trophic level); [2 max]

## SECTION B

Remember, up to TWO “quality of construction” marks per essay.

5. (a) enzymes most active at one temperature/optimum temperature;  
any deviation from that temperature lowers the enzyme activity;  
denaturing/change in active site/no activity at higher temperatures / inactivated at (very) low temperatures;  
increasing the substrate concentration increases the enzyme activity/more enzyme-substrate complex formed/more collisions between enzyme and substrate;  
eventually no increase in enzyme activity with increased substrate concentration / plateau when enzymes are working to the maximum/when all active sites occupied/saturated;  
*Accept answers shown graphically.*

[4 max]

- (b) example of competitive; (*e.g. malonate competes with succinate dehydrogenase*)  
example of non-competitive; (*e.g. opioids inhibit nitric oxide synthase*)

Competitive	Non-competitive
attaches to active site	attaches at place other than active site;
similar in structure to substrate	not similar to substrate;
does not change shape of enzyme	changes shape of enzyme;
increase in substrate concentration increases rate of reaction	increase in substrate concentration does not affect rate of reaction;

[5 max]

Award [2 max] for examples and [1] for each correct paired statements up to [3 max].  
Answers do not need to be shown in a table format.

- (c) take place in the stroma of the chloroplast;  
produce carbohydrates;  
ribulose biphosphate/RuBP is a five carbon compound;  
carbon dioxide fixed/added to RuBP / carboxylation;  
by RuBP carboxylase (enzyme)/Rubisco;  
forms unstable six carbon compound;  
this splits into (two molecules of) glycerate-3-phosphate/GP;  
ATP and NADPH produced in light-dependent reaction;  
ATP provides the energy;  
GP reduced to triose phosphate/TP;  
NADPH provides hydrogen;  
some three carbon sugars go to form hexose sugars;  
some go to making more RuBP;  
called the Calvin (Benson) cycle;

[9 max]

(Plus up to [2] for quality)

6. (a)  $G_1$  the cell grows/duplication of organelles;  
 S is synthesis stage when DNA is synthesized/replicated;  
 $G_2$  the chromosomes begin condensing/preparation for cell division;  
 $G_1$ , S and  $G_2$  make up interphase;  
 during mitosis nuclear division occurs/all four stages listed;  
 during cytokinesis cytoplasm/cell divides/daughter cells formed; **[4 max]**
- (b) monocotyledon seeds contain one cotyledon/seed leaf;  
 dicotyledon seeds contain two cotyledons/seed leaves;  
 monocotyledons have parallel veins;  
 dicotyledons have net-like veins;  
 monocotyledon stems have scattered vascular bundles;  
 dicotyledon stems have vascular bundles around edge;  
 monocotyledon roots are adventitious/fibrous;  
 dicotyledon roots are from radicle/tap root/branched;  
 monocotyledon flower parts/petals are (usually) in threes;  
 dicotyledon flower parts/petals are (usually) in fours or fives; **[5 max]**
- (c) (transpiration is) loss of water vapour from the leaves/stomata (and stems) of plants;  
 temperature, humidity, light (intensity) and wind all affect transpiration;  
 high temperatures increase evaporation rate of water/transpiration;  $\left\{ \begin{array}{l} \text{(accept)} \\ \text{converse)} \end{array} \right.$   
 high humidity lowers the rate of water evaporation/transpiration;  $\left\{ \begin{array}{l} \text{(accept)} \\ \text{converse)} \end{array} \right.$   
 air currents/wind increase water evaporation/transpiration; *(accept converse)*  
 high light (intensity)/sunlight (usually) increases photosynthesis/water evaporation through the stomata/transpiration;  
 stomata open to allow gaseous exchange/entry of  $CO_2$ ;  
 abscisic acid stimulates closing of stomata;  
 guard cells open/close the stomata;  
 adaptations of (xerophyte) plant structures reduce water loss/transpiration;  
 one example;  $\left\{ \begin{array}{l} \text{(thicker leaf cuticle / reduced surface area/rolled leaves/spines /} \\ \text{sunken/reduced stomata / close stomata in day / low growth form} \\ \text{/ CAM / C4 physiology)} \end{array} \right.$   
 second example; *(of above)* **[9 max]**  
*Award [8 max] if definition is missing.*

*(Plus up to [2] for quality)*



7. (a) Down syndrome is caused by non-disjunction;  
occurs during meiosis;  
chromosome pairs fail to separate in meiosis I / chromatids in meiosis II / anaphase II;  
some gametes have an extra chromosome;  
can lead to zygotes/individuals with an extra chromosome / individual has 47 chromosomes;  
in Down syndrome this would be trisomy 21/extra chromosome 21;  
increased probability with increased age of mother/ages of parents; [5 max]
- (b) skin colour is an example of polygenic inheritance;  
many/more than two genes contribute to a person's skin colour;  
due to the amount of melanin in the skin;  
combination of alleles determines the phenotype;  
allows for range of skin colours / continuous variation of skin colour;  
phenotypes do not follow simple Mendelian ratios of dominance and recessiveness;  
the environment also affects gene expression of skin colour / sunlight/UV light stimulate melanin production;  
the more recessive alleles there are, the lighter the skin colour; (*vice versa*) [5 max]
- (c) caused by gene mutation;  
(sickle-cell anemia) due to a base substitution (mutation);  
changes the code on the DNA;  
which leads to a change in transcription / change in mRNA;  
DNA changes from CTC to CAC/GAG to GTG / mRNA changes from GAG to GUG; { (accept DNA changes from CTT to CAT/GAA to GTA / mRNA changes from GAA to GUA)  
which (in turn) leads to a change in translation / change in polypeptide chain/protein;  
(the tRNA) adds the wrong amino acid to the polypeptide chain;  
glutamic acid replaced by valine;  
produces abnormal hemoglobin;  
causing abnormal red blood cell/erythrocyte shape / sickle shape;  
which lowers the ability to transport oxygen;  
sickle-cell allele is codominant;  
homozygote/Hb<sup>S</sup> Hb<sup>S</sup> have sickle cell anemia/is lethal / heterozygote/Hb<sup>S</sup> Hb<sup>A</sup> has the sickle trait/is carrier (and is more resistant to malaria); [8 max]

(Plus up to [2] for quality)

8. (a) heat causes vasodilation of arterioles;  
blood closer to surface so heat loss from skin;  
heat causes sweating (from sweat glands);  
evaporation of sweat leads to cooling;  
cold causes vasoconstriction of arterioles;  
less blood at surface so less heat loss from skin;  
cold leads to less sweating/evaporation of water from skin / hair becomes erect and traps air/goose bumps appear;  
temperature receptors in skin transmit impulses to the hypothalamus; [5 max]
- (b) level of progesterone falls before birth;  
oxytocin secreted;  
from pituitary;  
this stimulates contractions of uterus;  
uterine contraction/stretching of cervix/vagina stimulates secretion of (more) oxytocin;  
form of positive feedback; [4 max]
- (c) vaccine is a modified/weakened/attenuated form of a pathogen / contains antigens from pathogens;  
vaccine injected/ingested/introduced to patient;  
pathogen/antigens stimulates specific immune response called primary/initial responses;  
antigens stimulate macrophages/lymphocytes/T-cells;  
which stimulate cloning of B-cells/plasma cells;  
including development of memory (B-)cells;  
that produce specific antibodies;  
(upon second exposure) production of antibodies is much faster;  
higher level of antibody production / person has immunity;  
called secondary response;  
labelled graph showing curve with higher slope/peak for secondary response than primary response;  
may need booster shot to maintain immunity;  
this is an example of active/artificial immunity; [9 max]

*(Plus up to [2] for quality)*

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